Analytical Chemistry
Special Study 70-17
Job No. 1348046

DETERMINATION OF POLYCHLORINATED BIPHENYL RESIDUES IN RATS FROM 30 DAY AROCLOR FEEDING STUDIES

INTRODUCTION

One of the more significant objectives of the Aroclor - Environment program has been to develop a more complete picture of what occurs to Aroclor products once they are released to the ecosystem. The importance of this information is two fold, first it can be used to guide the development of a more "degradable" Aroclor product and secondly, the general methods developed to study the current Aroclor products can be used to determine the degree of control that must be exercised over the replacement products to avoid similar problems with these materials in the future.

As a part of achieving this overall objective, Industrial Bio-Test Laboratories was requested to carry out a 30 day tissue collection study in albino rats with Aroclor 1242, Aroclor 1254 and Aroclor 1260. This report deals with the subsequent analysis of these tissues for residual PCB's.

The details of tissue collection study can be found in the Industrial Bio-Test report, IBT No. B7009. A copy of this report is attached.

SUMMARY

The results of this study demonstrate that the residual PCB levels in all tissues decreased significantly as the degree of chlorination and the dietary exposure level of the material fed decreased.

Additionally, it was observed that the amount of isomeric alteration increased as the degree of chlorination decreased resulting in the fact that the major PCB isomers retained by the rats fed Aroclor 1242 were those predominantly present in Aroclor 1254 and Aroclor 1260. There were no significant differences in the type of isomeric alteration from tissue to tissue or between sexes.

RESULTS

The experimental data supporting the conclusions are shown in Tables I - III, and in Figures I - VIII.

DISCUSSION

All tissue samples were analyzed as outlined in Analytical Chemistry Method No. 70-1 and the PCB levels estimated using the Aroclor fed as the standard. Upon completion of the electron capture (EC) work all tissue extracts, for each Aroclor fed, were combined and concentrated. The concentrates were then further purified via liquid chromatography on alumina and subjected to high resolution gas

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chromatography on a support coated open tubular (S.C.O.T.) column in an attempt to identify as many of the remaining isomers and homologs as possible.

The EC chromatograms (Figures I-III) included in this report are representative of those obtained for each tissue (muscle, liver, kidney, and fat) and each Aroclor. For Aroclor 1242 the dominant PCB homologs retained are peak numbers, 8(tri); 10, 13, 14(tetra); 15, 16(penta); 20, 22(hexa); and 26(hepta). With Aroclor 1254 they are, 15(penta); 20, 22(hexa); and 26(hepta) and with Aroclor 1260 they are, 20, 22(hexa); 26, 27(hepta); and 28, 29, 30(octa). The fact that peaks 10, 13, 14, 15 and 16 are present in Aroclor 1242 extracts but not as dominant in Aroclor 1254 and Aroclor 1260 extracts seems to indicate that if the Aroclor 1242 dietary exposure level were reduced sufficiently these homologs would also be metabolized and/or excreted as they were with Aroclor 1254 and 1260. The very refractory homologs appear to begin with peak #20 in the penta-hexachlorobiphenyl region.

EC chromatograms of fractionated Aroclor 1130 and MCS 1016 (Figure IV) are included for comparison purposes. From these, it can be readily seen that these materials are a marked improvement over Aroclor 1242 in that they contain no observable amounts of the homologs that build up.

The S.C.O.T. column chromatograms (Figures VI-VIII) of the concentrated extracts are even more instructive in that the greater separation power of the column allows the identification of some of the PCB isomers that are not retained. For example, only traces of the following biphenyl isomers, dominantly present in the material fed remain: 2-chloro; 3-chloro; 4-chloro; 2,6-dichloro; 2,4-dichloro; 2,5-dichloro; 2,3'-dichloro; 2,4'-dichloro; 2,5,2'-trichloro; 3,3'-dichloro; 3,4-dichloro; 3,4'-dichloro; 4,4'-dichloro; 2,3,2'-trichloro; 3,4,2'-trichloro and 2,3,4'-trichloro.

The S.C.O.T. column chromatograms (Figure IX) of the proposed substitutes are again included for comparison purposes.

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TABLE I

ESTIMATED PCB CONTENT OF RAT TISSUES

Test Compound	Sex	Dietary Level	FAT ppm Found		KIDNEY ppm Found		LIVER ppm Found		MUSCLE ppm Found	
			Wet Wt	Lipid Wt	Wet Wt	Lipid Wt	Wet Wt	Lipid Wt	Wet Wt	Lipid Wt
AROCLOR 1242	M	300	-	-	1.40	12.4	2.70	60.6	5.00	37.3
	F	300	276	395	2.30	28.1	4.60	220	12.2	58.3
	M	1000	377	816	5.00	276	10.5	753	16.9	736
	F	1000	412	722	2.30	146	17.4	793	29.0	855
AROCLOR 1254	M	300	695	1094	7.90	655	56.9	2370	55.8	1396
	F	300	660	1289	12.9	1895	53.7	3358	36.0	1274
	M	1000	4660	7208	46.6	3325	176	5318	271	7735
	F	1000	3430	7544	156	12972	227	6678	167	6202
AROCLOR 1260	M	300	2130	3061	28.8	2056	126	3808	81.6	2470
	F	300	2035	3430	16.0	2671	125	6226	136	4849
	M	1000	9190	13715	72.5	5181	200	6263	266	8879
	F	1000	11970	19088	91.0	7579	206	10300	555	24111

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TABLE II
ELECTRON CAPTURE GAS CHROMATOGRAMS

Chromatographic Conditions

Instrument: Hewlett-Packard Model 402

Type Detector: Ni^{63} Electron Capture

Column: 6' X 4 mm glass U, 4% XE-60 on 80/100 Mesh Chromosorb W, HP

Column Temperature: 200°C

Detector Temperature: 300°C

Injection Port Temperature: 220°C

Carrier - He, 60 ml/min

Purge - Ar/CH_4 (g/l) 120 ml/min

Electron Capture Peak	Dominant Homolog as Identified by GC/MS		
	Aroclor 1242	Aroclor 1254	Aroclor 1260
1	1	-	-
2	1	-	-
3	2	-	-
4	2	-	-
5	3	-	-
6	3	-	-
7	3	-	-
8	3	-	-
9	3	-	-
10	4	4	-
11	4	4	
12	4	4	-
13	4	4	-
14	4	5	5
15	-	5	5
16	-	5	-
17	-	5	6
18	-	6	6
19	-	6	6
20	-	6	6
21	-	6	6
22	-	6	6
23	-	-	7
24	-	-	7
25	-	-	7
26	-	-	7
27	-	-	7
28	-	-	8
29	-	-	8
30	-	-	8
31	-	-	8

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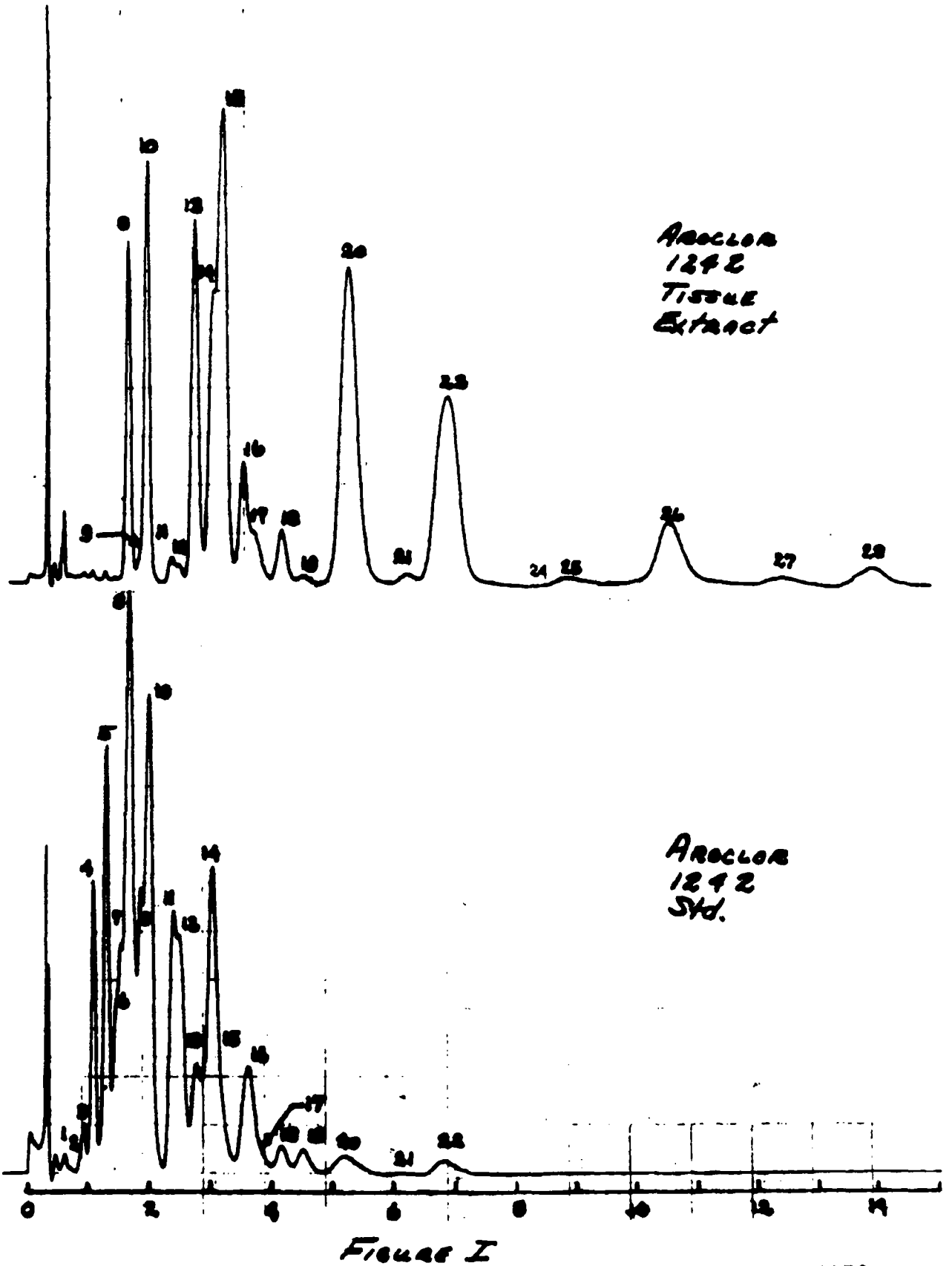

FIGURE I

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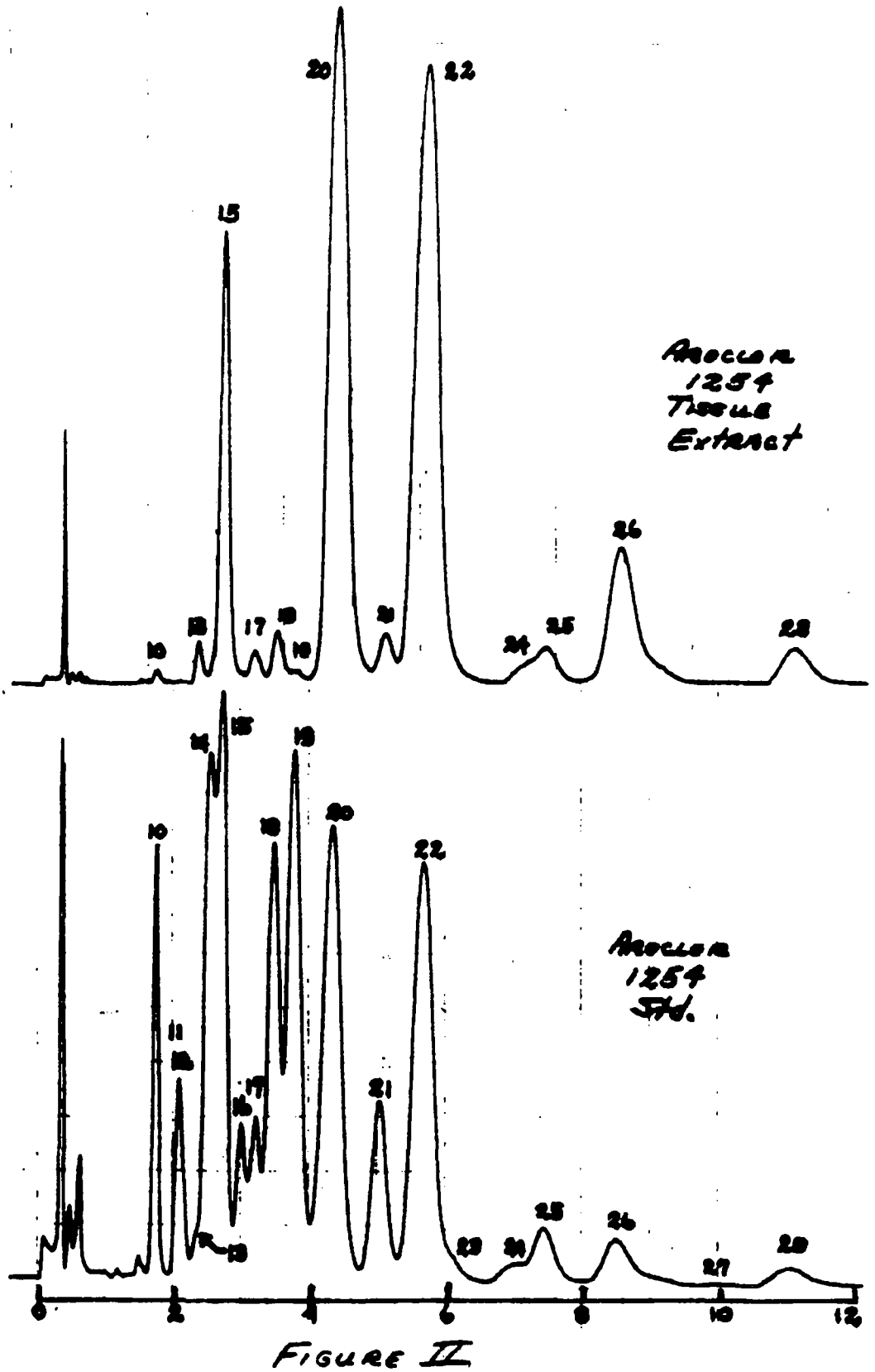

FIGURE II

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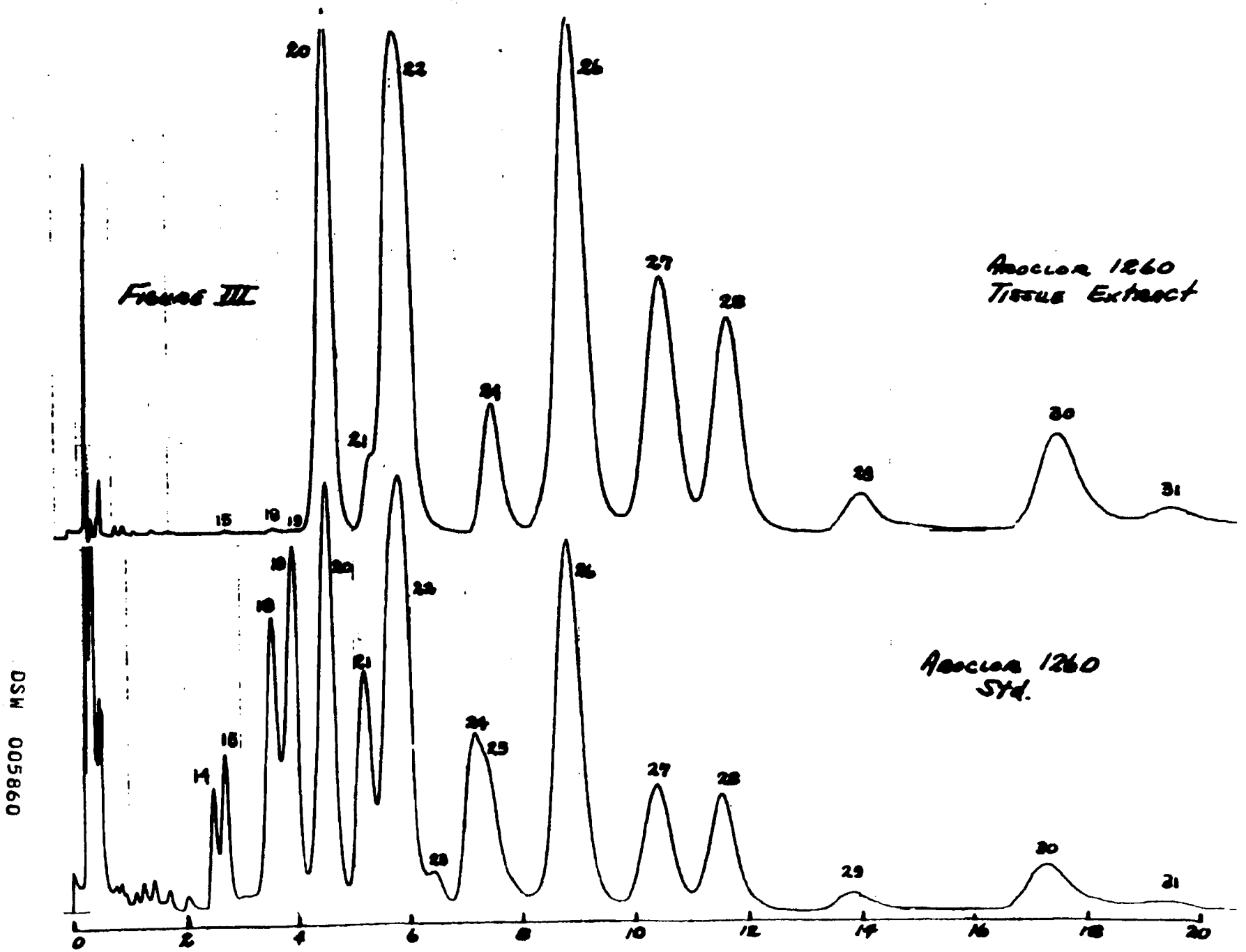

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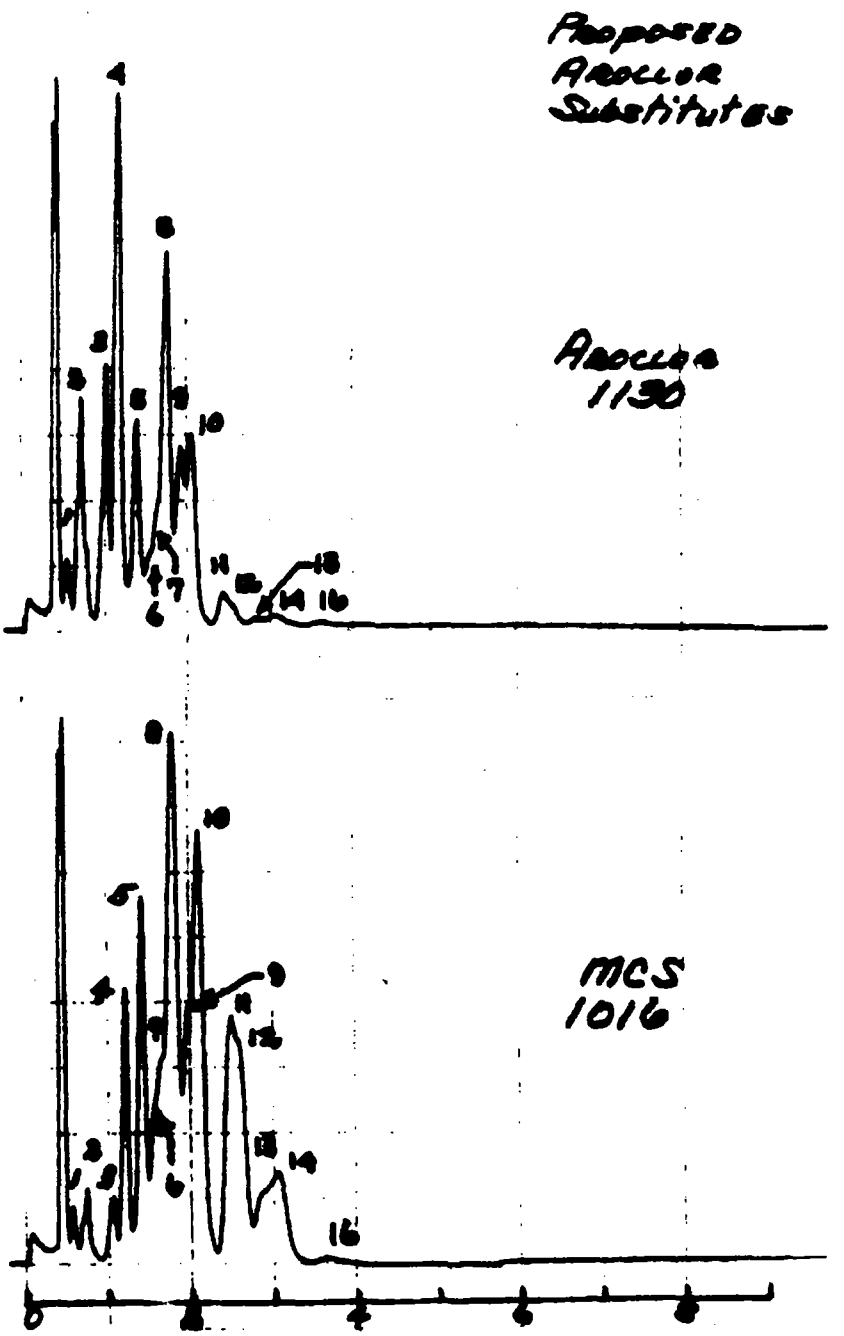

FIGURE IV

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TABLE III

FFAP S.C.O.T. COLUMN CHROMATOGRAMS

Chromatographic Conditions

Instrument: Perkin-Elmer Model 800 equipped with a 30/1 sample inlet splitter

Type Detector: Flame Ionization

Column: 100' X .02" FFAP S.C.O.T. Column

Column Temperature: 235°C

Detector Temperature: 280°C

Injection Port Temperature: 340°C

Carrier Gas - Helium @ 15#

FFAP S.C.O.T. Column Peak No.	Compound As Identified by Retention Time	Number of Chlorines
1	Biphenyl	0
2	2	1
3	3	1
4	4	1
5	2,6	2
6	2,2'	2
7	2,4	2
8	2,5	2
9	2,3'	2
10	2,4'	2
11	-	3
12	2,5,2'	3
13	3,3'	2
14	3,4	2
15	3,4'	2
16	-	3
17	4,4'	2
18	2,3,2'	3
19	2,5,4'	3
20	-	3
21	3,4,2'	3
22	-	3
23-26	-	3
27	2,3,4'	3
28-37	-	4
38	3,4,4'	3
39-42	-	4
43-49	-	5

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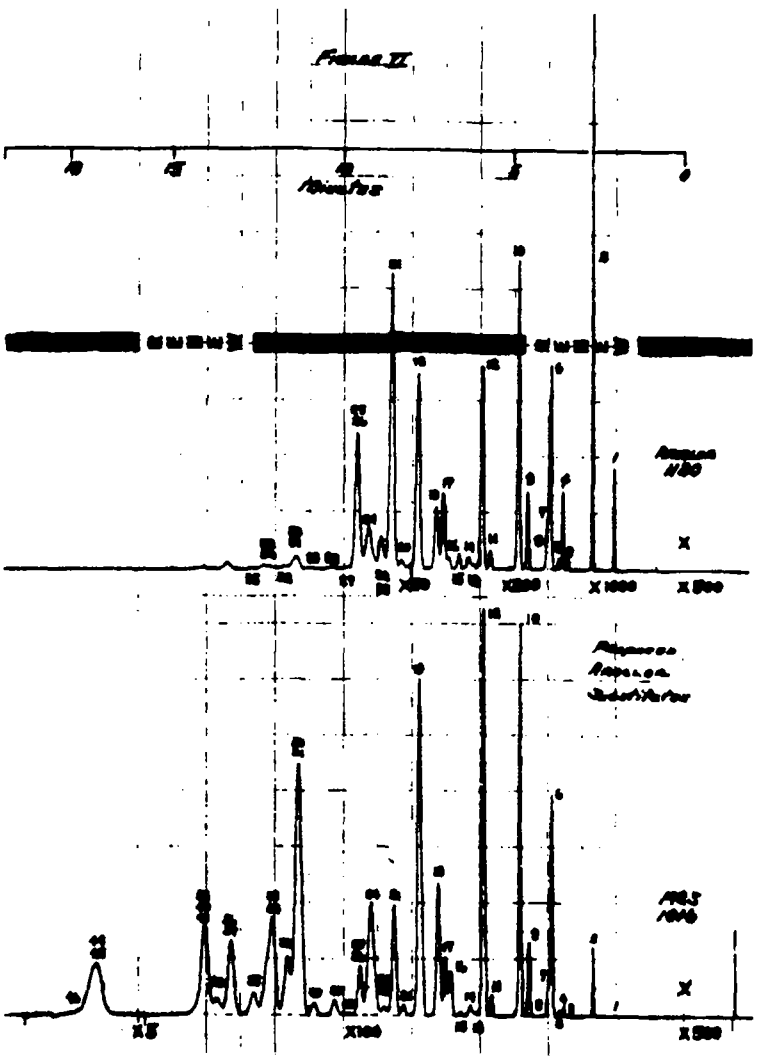

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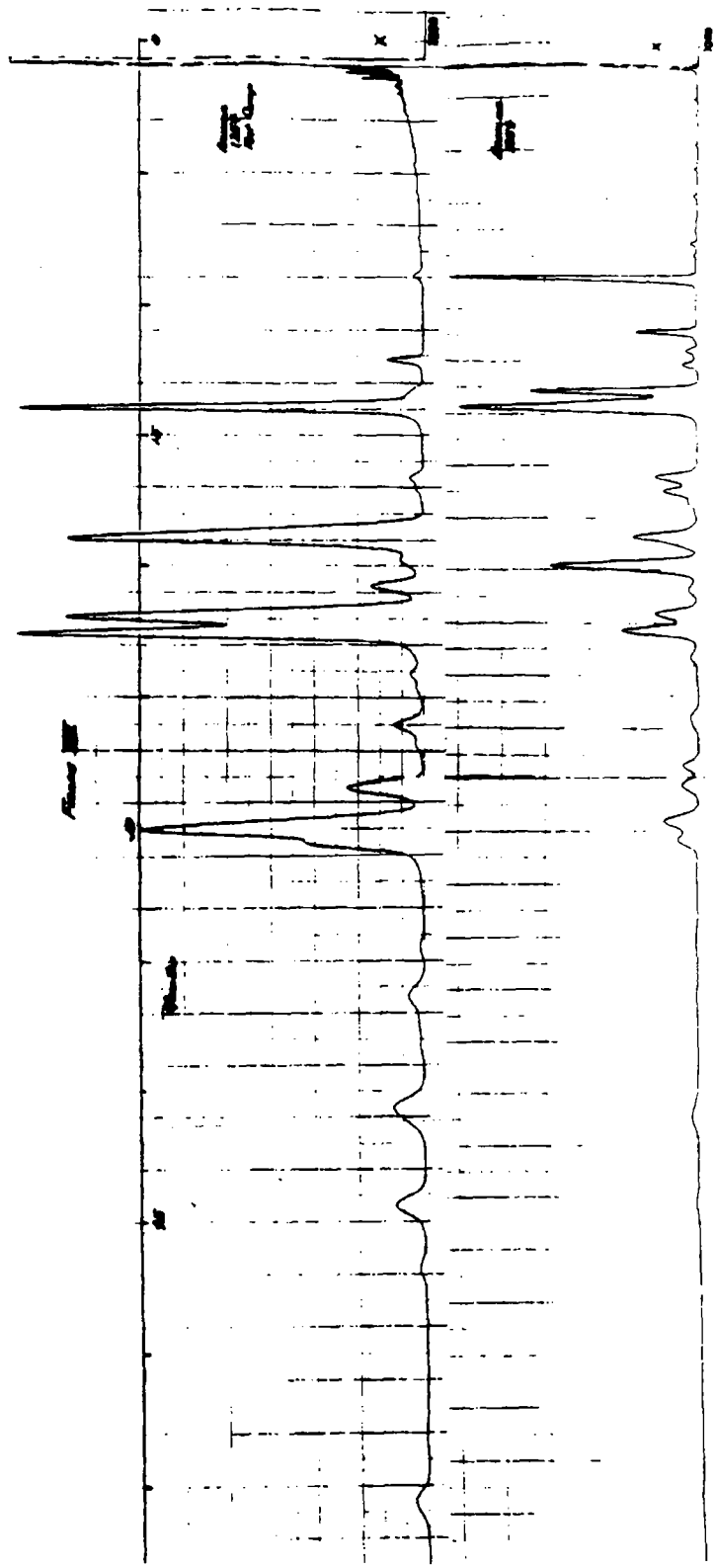

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